FIRST FLYING TECHNIQUES
TRIM AN AIRCRAFT

1. Introduction

We aim to teach and demonstrate how to operate a general aviation aircraft and show some basic techniques and manoeuvres that every real pilot must have learnt to be licensed.
In this document, we will learn how to trim our aircraft and stabilize it without input on the flight controls.

We use the Cessna 172 as training aircraft which is also a default aircraft in most flight simulators.

Understand we are not learning to fly the Cessna 172 specifically.
We will not review specific practical aspects about this aircraft.

2. Theoretical Knowledge

Your aircraft possess flight control surfaces. This surface will generate different amounts of lift.
For example, to manoeuvre around the roll axis, you will deflect downward one aileron to temporary increase lift on one wing and deflect upward the other aileron to temporary destroy a part of the lift on the wing.

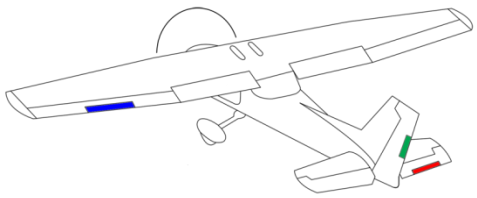
By default, you aircraft will be stable in pitch for a given airspeed.
If you are not at the correct airspeed, you aircraft attitude will naturally evolve as to return to this airspeed.
In other words, if compared to that airspeed you're trimmed for, you are:

- Too slow: your aircraft will tend to pitch down to accelerate
- Too fast: your aircraft will tend to pitch up to slow down.

Since an aircraft is flying at different speeds depending on its flight phase, we need to be able to adjust this speed at which our aircraft will be stable.

This is called to trim the aircraft.

Small parts of the flight control surfaces, including also ailerons and rudder, will be deflected with precision to stabilize the aircraft at the required pitch. See below coloured parts representing them.



It is important to trim your aircraft always **after** you have finished manoeuvring your flight control. For example, trimming an aircraft while turning is non-sense since the trim setting during the turn is completely different from the trim setting in straight steady flight.

Basically, aircraft can be trimmed for each axis:

- Pitch trim: adjusting the elevator or part of the elevator to lock the pitch angle (red part).
- Roll trim: adjusting the ailerons to compensate for an induced roll for example following the loss of one engine or an unbalanced fuel distribution (blue part).
- Rudder trim: adjusting the yaw resulting from propeller effects or from the loss of one engine (green part).

Some aircraft will possess a take-off trim position to help the pilot initiate the rotation of the aircraft.

3. Practical Aspects

3.1. Principle

We can observe trim position, flight control position and aircraft attitude in the following examples.

Remember that if your aircraft is badly trimmed, it will tend to adopt an unwanted pitch attitude which will result in an undesired climb or descent.

Here we are in standard level flight, without altitude change.

Only to illustrate the powerful advantage of trimming the aircraft, we can see for example that a full deflection of the control surface can be countered by the trim.

If you set the trim fully down slowly and counter the pitch down effect by pulling the flight controls progressively in order to maintain straight level attitude, you will maintain a constant altitude despite pulling the flight control completely!

Small speed decrease can be observed because of the induced drag.

Left – Full up

Right – Full down

This particular situation could result from a trim runaway.

3.2. Method

Contrary to the previous case, we usually try to achieve a neutral flight control position by finding the correct trim setting. This way we can maintain the desired attitude without pushing or pulling the flight control continuously, which requires strength in real aircraft.

To successfully trim the aircraft, the following method should be followed:

1. Move your flight control to obtain the desired attitude
2. Lock the position of your flight control in order to maintain your aircraft attitude

The goal is now to suppress the effort you are doing on the flight control in order to return to the neutral position.
You need to perform the following actions **simultaneously**:

3. Move the steering wheel or use the trim control to support your attitude change
4. Return gently to the neutral position
5. When approaching the neutral position for the flight control, move the trim position bit by bit.

Your trim process will be perfect if your attitude does not change at all.

3.3. Influence of airspeed

When your aircraft is trimmed, as we said, it will be trimmed for the specific airspeed you are maintaining. If your airspeed changes, you need to adjust the pitch trim position.

For two different airspeeds, we can see two different trim positions
In addition, notice again that since we are slower (right), the pitch angle is higher (left) and confirmed by trim.

4. Conclusion

Being able to trim the aircraft will help you flying your aircraft.

It will also allow you to focus on other aspects of your flight (managing instruments, checking parameters, etc…) without risking a change of attitude.

The aircraft trim method should be used in other manoeuvres like straight level flight, climb, descent, approach, etc…